Scientists test a microalgal technology for wastewater treatment

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Members of the University of Turku, with participation of their colleagues at the Faculty of Biology of the Lomonosov Moscow State University, have proved that under Nordic conditions, wastewater could be treated with the help of microalgae, while algal biomass is suitable for processing into biofuel. The scientists have presented their optimized technique for removing organic compounds, nitrogen and phosphorous from wastewater in the journal *Algal Research*.

People have used algal ponds for wastewater treatment since ancient times. It was especially popular in countries with ample sunlight but lacking stationary treatment facilities. In India, algae ponds are used for community wastewater treatment, but no one knows precisely when they emerged. William Oswald, the pioneer of algal wastewater biotreatment, developed a solid scientific foundation for this technique more than 50 years ago. Over the last decade, green wastewater treatment technologies have attracted considerable attention, resulting in dozens of academic papers published yearly.

Scientists distinguish two types of microalgal cultivation systems: open (ponds, lagoons) and closed (photobioreactors). Due to the technical complexity and high cost, photobioreactors were not considered for wastewater treatment. The Russian biologists, together with their colleagues from the University of Turku (Finland), carried out pioneering research on optimization of a photobioreactor-based method under Nordic conditions.

Photobioreactors are closed vessels harboring microalgae cell suspension, where required conditions are maintained. Such parameters as uniform illumination, constant temperature and concentration of carbon dioxide, oxygen and nutritional chemicals provide the necessary environment. Constant stirring is also required—the suspension should be stirred at a speed that prevents cell sedimentation. Photobioreactors differ in form and construction, including plate, tubular and helical forms.

The efficiency of wastewater treatment efficiency is checked by specialists in the outflow of the photobiotreactor. There are two efficiency characteristics: the pollutant removal completeness and its rate.

The scientists used Chlorella vulgaris UHCC0027—a microalgal strain isolated in southwestern Finland, its natural habitat. Photobioreactors with such algae could be operated without additional heating since all biological processes effectively proceed inside the system under ambient temperature. This is the main outcome of the research.

Biologist Alexei Solovchenko, one of the research participants, says, "The guiding principle applied for obtaining and choosing strains for biotreatment purposes is very simple. The most promising organisms are often isolated from the treatment facilities and surrounding territories. It was curious that an alga from the Nordic collection has proved worthy in the process of research. However, an indigenous algal community from the same wastewaters eventually matched the algal monoculture in the efficiency of treatment.:

Moreover, microalgal biomass growing in wastewater has proved suitable for conversion into biodiesel with minimum amendment. Basing on the achieved knowledge, researchers could design more advanced biotechnologies for wastewater treatment and biofuel production under

Nordic conditions.

Solovchenko says, "Business considers algal biotreatment very promising. For instance, our project has been done on the basis of a Finnish commercial firm, professionally dealing with wastewater treatment. Its members also took part in our work. What is important is that we've achieved rather fair results, using pure municipal wastewater taken from the Turku network and not wastewater from model environments, which is applied in most studies."

More information: Mikael Jämsä et al, Nutrient removal and biodiesel feedstock potential of green alga UHCC00027 grown in municipal wastewater under Nordic conditions, *Algal Research* (2017). DOI: 10.1016/j.algal.2017.06.019

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